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Time-resolved Temperatures of Shock-compressed and Detonating Energetic Systems,*

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The chemical processes occurring in shock-compressed and detonating high explosives have been studied by using fast time-resolved emission spectroscopy and a two-stage gas-gun. The emission spectra from shock-compressed nitromethane, tetranitromethane and single crystals of PETN are typically strong but very broad and structureless, likely representing thermal emission. The temporal profile in emission intensity is composed of three distinct steps including (1) a small initial jump representing shock-initiation, (2) a strong jump representing thermal explosion in shock-compressed and/or reacting materials, and (3) a decay to a steady-state representing a transition to the detonation of uncompressed high explosives. This observation is consistent with the thermal explosion model previously suggested by Campbell *et. al.* Assuming the emission to be thermal from a gray-body, the intensity of the emission can be correlated to the temperature changes in shock-compressed and detonating high explosives. The temperature at the C-J state is then found from the steady state value. We report the C-J temperatures of 3800 K for nitromethane, 2950 K for tetranitromethane, and 4100 K for PETN. The data reported in this work can be used to guide the theoretical models describing detonation chemistry. In this paper we also compare the data with the chemical equilibrium models.

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